

Athanasius Kircher (1602-1680) on Noah's Ark: Baroque "Intelligent Design" Theory

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The Jesuit Polymath Athanasius Kircher (1602–1680) has lately been characterized as “the last man who knew everything” (Findlen 2004). He certainly knew, and wrote about, a great deal (Godwin 1979). Knowing “everything” obviously was a lot easier in the Baroque era than it is today. But more was required than just brute memory. Kircher attempted to create a universal knowledge system, including the apparatus necessary for managing it. That meant elaborating techniques for organizing, classifying, and cataloging knowledge. Indeed, he made a substantive contribution to the approach that is still used in structuring libraries and creating information retrieval systems. An approach like his assumes that the knowledge to be organized is already at hand, or at least that it can be supplied by filling in the blanks.

Kircher's thinking was obviously grounded in Christian theology and the philosophy that supported it. For Kircher, the object of knowledge was God's thought, and it was to be obtained from the *Bible* on the one hand and from the natural revelation that was manifested in the creation. Knowledge was to be found in the order of things reflecting the ideas of the Creator, and therefore in classification and in the language that expresses that classification. It was not derived through observation and experiment of the sort that was advocated by some of his contemporaries, such as Galileo. Moreover, he embraced a kind of mysticism that strongly affected his thinking about scientific topics. He was, thus, a transitional figure in the history of early modern science. And, for that reason, his work is particularly instructive as an example of efforts to reconcile traditional scholarship with the kind of scientific knowledge that was emerging at the time.

Kircher of course accepted the biblical account of the creation of the world and its inhabitants in six days. Likewise he rejected the heretical view that the earth moves round the sun. But what is most striking to us moderns is his vision of the overall plan of creation, as explained in his *Ars Magna Lucis et Umbrae* [*The Great Art of Light and Shadow*] (Kircher 1646). It was not just that God created man in His own image, as is stated in the *Bible* (*Genesis* 2:27, 5:1). The world in its entirety reflected the same basic pattern. In other words, Kircher accepted the macrocosm-microcosm analogy, with its system of mystic correspondences between the parts of the human body (microcosm) and the parts of the universe as a whole (macrocosm). He even envisaged the brain as analogous to a theatre in which a kind of drama gets acted out. In the light of Christian theology, there is nothing exotic about that. The structure of the world is presented by God's words. To speak for Him meant to create. This systematics reflects the grammar of God's language. When man could adapt his language to God's, his mind would represent the world as God had designed it. That notion provided for a systematic correspondence between the intellect and the material world. The rules, grammar, and vocabulary would be one and the same. Because the human mind and body on

the one hand and the world as a whole on the other are modeled upon the Divine Mind, an understanding of that Mind provided the key to understanding the natural world as well. That, of course, required some intellectual apparatus, which Kircher was particularly well qualified to supply.

One source of knowledge was the study of language, as expounded among other places in a book entitled *Turris Babel* [*The Tower of Babel*] (Kircher 1679). Kircher's views on these matters were influenced by the Cabbalah and other occult metaphysical sources that are often discussed under the rubric of the "Hermetic tradition" (Yates 1964, 1979; Idel, Kiener, and Dan 1986). One notion that he derived from such sources was that God has a perfect language, and it was in that language that God spoke to Adam and Eve in the Garden of Eden (cf. Eco 1995). As the *Bible* (*John*, 1:1) puts it, "In the beginning was the Word, and the Word was with God, and the Word was God." That language, which had subsequently been lost, would have provided a much better access to reality than those that were spoken later. Consequently, there was a strong motive for reconstructing it. The grammar would give the fundamental laws of the universe. If one could find the laws in all languages, then one would have a formula for knowing everything. Kircher explained how he thought that this could be accomplished in a book entitled *Oedipus Aegyptiacus* [*The Egyptian Oedipus*] (Kircher 1652–4), in which he claimed to have discovered the secret of hieroglyphic writing (Schmidt-Biggemann 2001). Even the less perfect languages were thought to provide access to the divine reality. Hence the etymologies of words were taken very seriously indeed as indicators of the nature of the things to which they refer.

Kircher's manner of reasoning is well exemplified in an exegesis of the Biblical account of the Noachian Deluge in *Arca Noë* [*Noah's Ark*] (Kircher 1675) (Fig. 1). The main focus here is not the Flood, but the vessel. Working its structure out, even to the minutest detail, was a way of making the fundamental laws that govern everything explicit. His reason for giving such a detailed account was not to provide the reader with useful information, but rather to show that everything is consistent. As Kircher explains, Noah was just the fabricator of the Ark; God himself was the architect. Indeed, God went so far as to instill into Noah the knowledge of how to construct the Ark (pp. 23–24). So the Ark would be a marvelous work, comparable to the seven wonders of the ancient world (p. 1). Reconstructing it may be considered an exercise in "intelligent design," in so far as the imperfect, human intellect might approach the problem through understanding the perfect, divine intellect. The Ark, its contents, and their systematic arrangement, would all be concrete manifestations of God's intelligence. It would be a kind of model of everything.

The account in the 6th book of *Genesis* is very sketchy. The King James version reads:

14 Make thee an ark of gopher wood; rooms shalt thou make in the ark, and shalt pitch it within and without with pitch.

15 And this is *the fashion* which thou shalt make it of: the length of the ark *shall* be three hundred cubits, and the height of it thirty cubits.

16 A window shalt thou make in the ark, and in a cubit shalt thou finish it above; and the door of the ark shalt thou set in the side thereof; *with* lower, second and third *stories* shalt thou make it.

Kircher was an accomplished linguist, and he provided not only a quotation from the Vulgate, but also versions in Hebrew, Greek, Arabic, Chaldean and Syriac, each with a Latin translation (pp. 16–18). Kircher figured out that "gopher wood" is really several kinds of wood (p. 19), and elucidated what is meant by the "bitumen" or pitch that was used in calking (20–21). He explains, in great detail, what a cubit is, and then goes on to calculate the volume of the Ark, 300 cubits long



by 50 cubits wide by 30 cubits high gives 450,000 cubic cubits. The arithmetic is quite straight forward, and does not do justice to the fact that Kircher, although he made a fool of himself by claiming to have squared the circle, was an outstanding mathematician. The reasoning behind the proportions, which gave him the width, is a bit more obscure. It derives from the macrocosm-microcosm analogy mentioned above. Kircher believed that man was created in God's image, and concluded that the proportions of the Ark would be those of the human body (pp. 33-34) (Fig. 2).

That allowed him to conclude that the Ark was 50 cubits wide. He seems to have applied this criterion without feeling any need to justify it or to consider any alternatives. A diligent scholar, Kircher did cite earlier authors for alternatives to his reconstruction of it as a barge-like vessel (p.43).

The basic plan was a kind of rectangular box (Fig. 3), with three levels, each containing corridors and rooms, covered by a sloping roof with a peak along the midline of the vessel. The birds were housed together with people on the top level, the remaining animals on the bottom level. The supplies and equipment were stored in between. Kircher's diagram shows the precise arrangement of rooms in the Ark, and enumerates which animals or supplies were housed in each of them. Down below there were bilges into which excrement made its way.

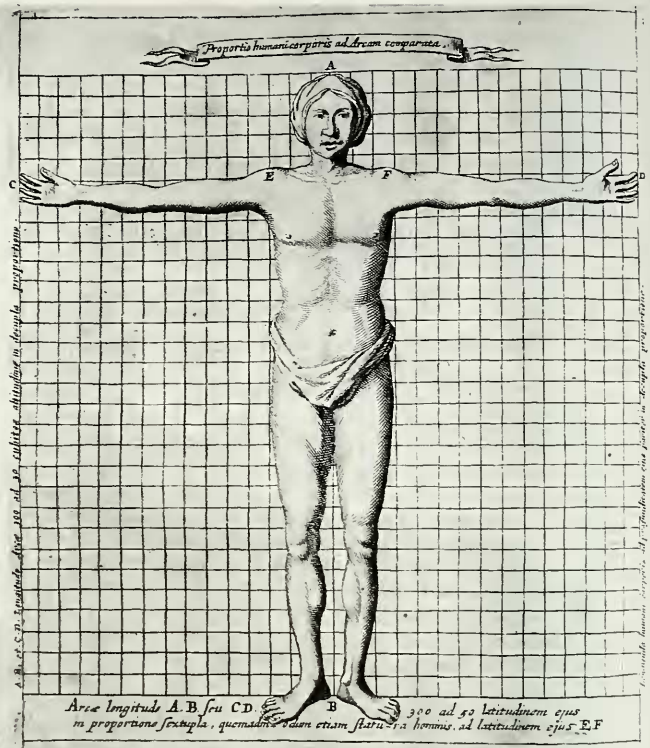


FIGURE 2. Proportions of the human body used to infer those of the Ark. (Kircher 1675)

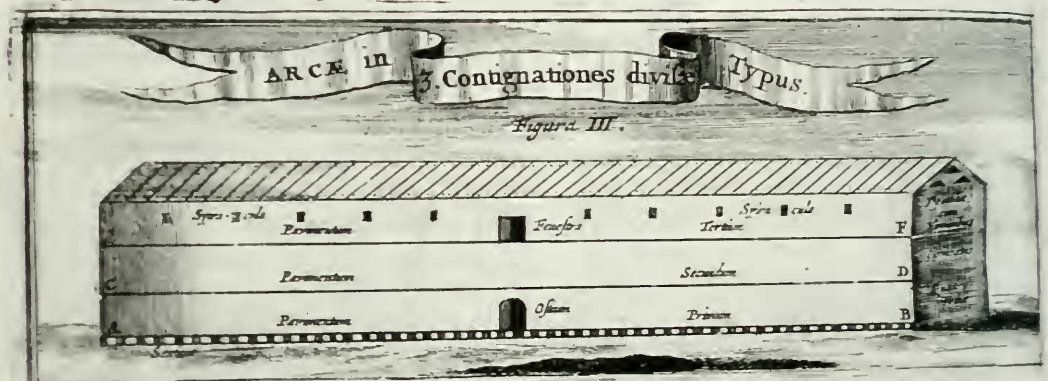


FIGURE 3. The Ark. (Kircher 1675)

The relative dimensions of the rooms within are evident from the floor plans (Fig. 4), and from a perspective view that is presented at the end of the first section of the book (Fig. 5). We will not go into the details with respect to living quarters, because for our purposes what is really interesting is how Kircher decided which animals had to be accommodated and which did not. Obviously there had to be room for fully terrestrial animals such as birds and mammals, which otherwise would drown along with the wicked human beings. Also on board were a few snakes (Fig. 6) and semi-aquatic creatures such as crocodiles and seals.

Kircher's list of fully terrestrial animals on board the Ark begins with the elephant, and that at least happens to be the one with which the Roman naturalist Pliny begins in his famous *Natural History*. At any rate, big animals come first, small animals last. The Latin names are so familiar as modern genera that we might as well provide the originals: 1) *elephas* [elephant], 2) *camelus* [camel], 3) *bos* [cattle], 4) *monoceros* or *unicorvus* [unicorn], 5) *rhinocerotum* [rhinoceros], 6) *bubalus* [buffalo], 7) *alce* [elk], 8) *equus* [horse], 9) *tigris* [tiger], 10) *ursus* [bear], 11) *leo* [lion], 12) *cervus* [deer], 13) *asinus* [ass], 14) *ouager* & *bouasus* [wild ass], 15) *lupus* [wolf], 16) *pardus* or *panthera* [panther], 17) *capra* [goat], 18) *ovis* [sheep], 19) *porcus* [pig], 20) *canis* [dog], 21) *vulpes* [fox], 22) *felis* or *cattus* [cat], 23) *lepus* [hare], 24) *cuniculus* [rabbit], 25) *sciurus* [squirrel], 26) *mustella* [weasel], 27) *viverra* [ferret], 28) *taxis* or *uelus* [wolverine], 29) *glis* [mouse], 30) *eri-*

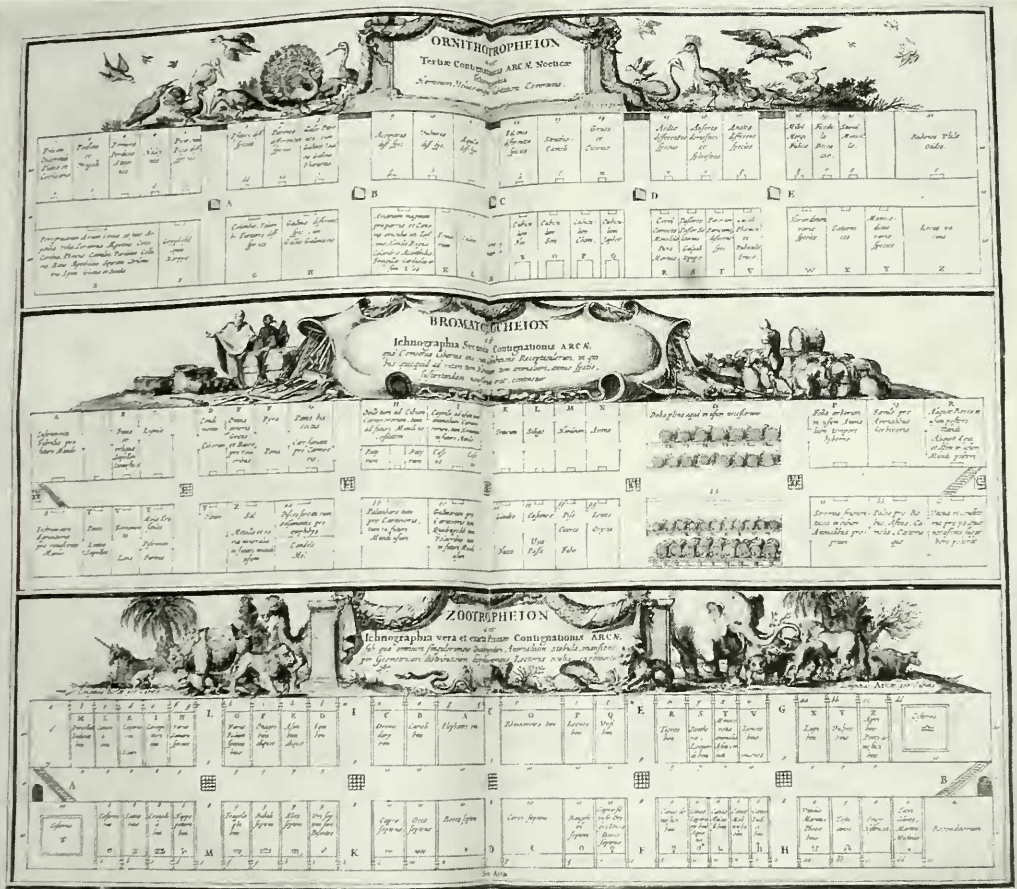


FIGURE 4. Floor plan for the Ark. (Kircher 1675)

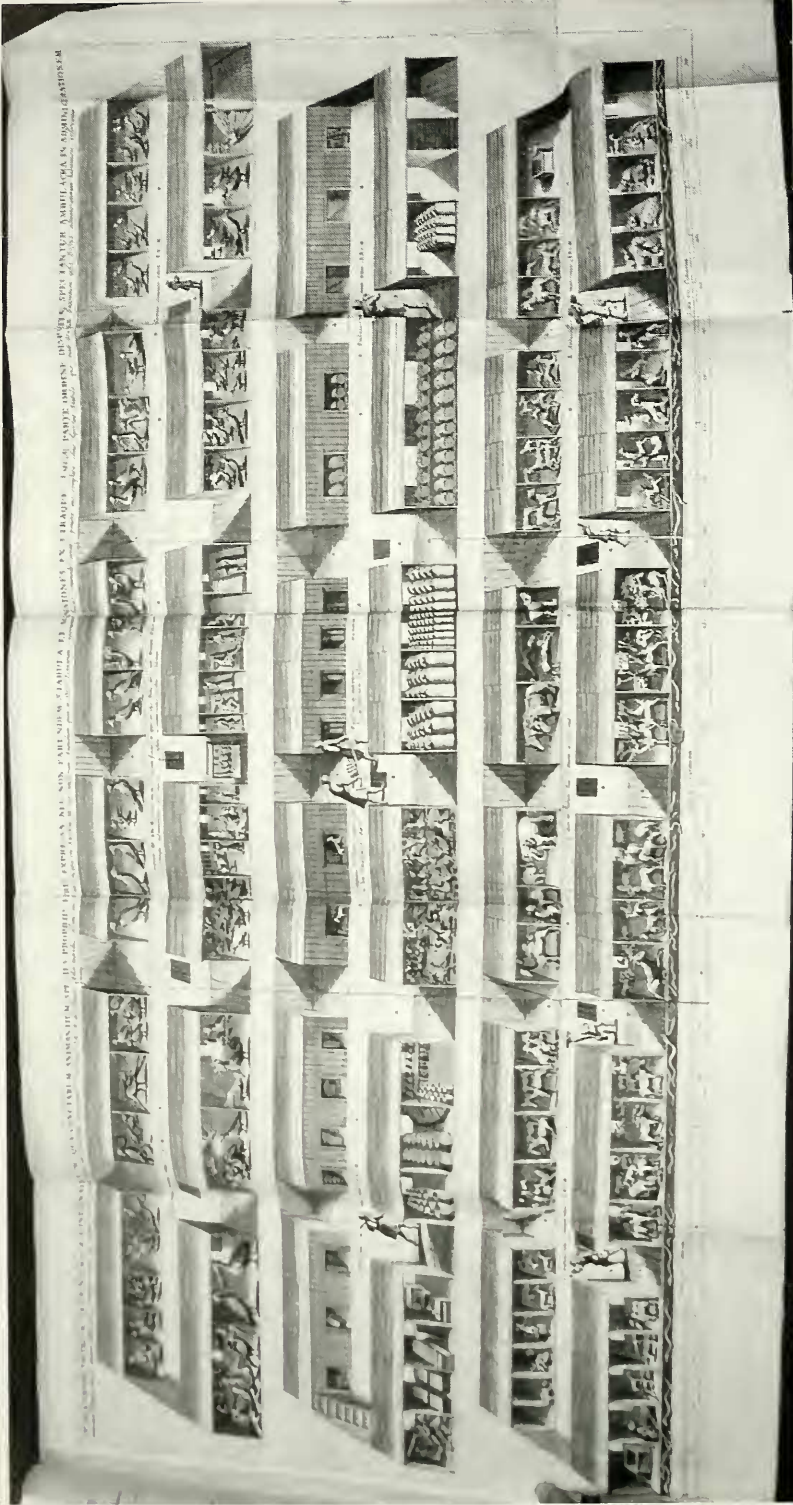


FIGURE 5. Perspective view of the Ark with its passengers and cargo on board. (Kircher 1675)

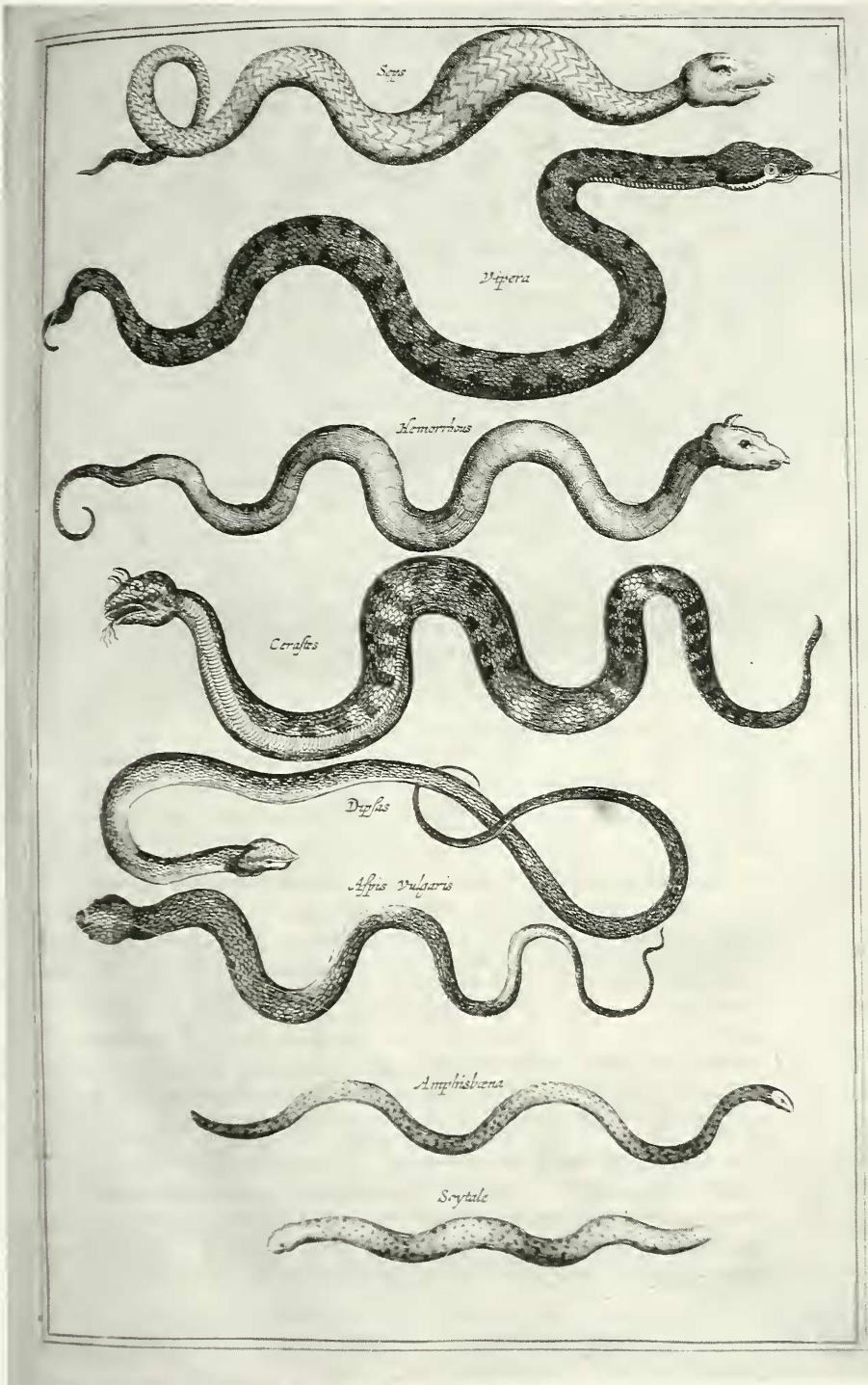


FIGURE 6. Snakes on the Ark. (Kicher 1675)

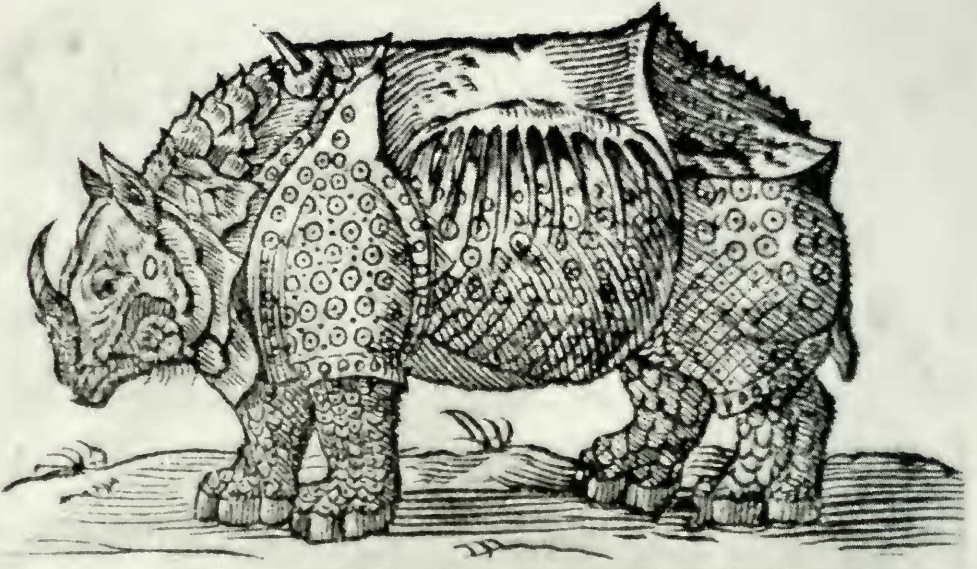


FIGURE 7. Rhinoceros as depicted in *Arca Noë*, evidently copied from Gesner. (Kircher 1675)

uaceus [hedgehog], 31) *histris* [porcupine], 32) *simia* [tailless monkey], 33) *cercopithecus* [tailed monkey]. From his illustrations it is obvious that Kircher relied heavily on the work of the great Swiss naturalist Conrad Gesner (1516–1565) for his information about the diversity of animals (Fig. 7). There is no obvious classification in any of his lists of animals, and the order is not always the same. A few forms that are not listed earlier, such as the dromedary and the lynx, are indicated on the floor plan. Also there are some ambiguities, for example because there are four rooms for dogs. Be this as it may, the list, including both fully terrestrial mammals and those that are semi-aquatic, amounts to no more than fifty pairs. That obviously does not account for the full diversity of mammals, even from the biota known to him at the time, and it is interesting to see how he copes with that apparent difficulty.

To begin, he explicitly excludes certain animals on the basis of their being the product of a kind of hybridization. Although he notes that mules are sterile, this fact does not stand in his way. Thus he treats the giraffe as a cross between a camel and a leopard. He duly notes the etymology: *camelus* [camel] and *pardus* [panther], giving *camelopardus* [camelopard] (p. 68). By the same token, *leopardus* [leopard] is a cross between *leo* [lion] and *pardus* [again, panther]. He gives several other examples. The etymology reflects his notions about the relationship between language and the plan of creation. The folk terminology was not viewed as metaphor or figure of speech, but as a manifestation of underlying reality. Combining terms means combining essences. So the hybridity could be established without recourse to observation. The combinations of words confirmed the combination of the organisms. For Kircher, combinatorics was a fundamental technique for working out the possible configurations of nature. According to his approach, every natural object is represented by a term. The rules by which terms are to be combined are anything but accidental. Rather they reflect, more or less perfectly, the original language of God. As any term represents part of the cre-

ation, the grammar for combining terms must parallel the systematics of the natural objects designated by the terms. Creation was nothing other than the expression of syllables of which the terms are formed, so that the words are the primary realities. Natural objects are therefore ordered according to the grammar that determines how the words are used. Thus the rules that permit identification of how the terms are combined are essential for understanding the systematics of nature. Combinatorics crops up again in his discussion of the groups of animals that are considered edible or not according to the Jewish dietary rules (pp. 99–100).

Kircher was also able to increase the amount of biotic diversity after the flood on the basis of the animals becoming modified by environmental conditions (pp. 94–97). This capacity was divinely ordained. He suggested that when animals move into colder or warmer climates they can be transformed to a considerable extent. Thus, deer become reindeer. Kircher was familiar with some of the creatures that were being discovered in the New World, and were only beginning to be described in the scientific literature. He treats armadillos, which were present in the collections of the museum that he supervised in Rome, as of doubtful presence on the Ark. They seemed to be a combination of the turtle and the porcupine [*hystrix*] (p. 69). The Australian fauna was as yet unknown. How the mammals dispersed to the remote parts of the world after the deluge was a bit of a problem (195–196). The notion that the flood was not universal would have allowed for refugia, but it had already been condemned as heretical. Kircher therefore suggested land bridges, island hopping, swimming, and human agency as mechanisms.

The “lower” animals were taken care of by means of spontaneous generation. This maneuver seems a bit forced, since the biblical account refers to “every creeping thing” having been on the Ark (*Genesis* 6:20, 7:14, 8:17, 8:19). Since antiquity it had been generally taken for granted that insects and other small animals can arise from mud or decaying flesh. This notion had been sanctioned by Aristotle, and was taught in the medical curriculum at the time. Kircher’s book *Mundus Subterraneus* [*The Subterranean World*] (Kircher 1665) discusses a range of natural history topics including geology, hydrography, mineralogy, toxicology, metallurgy, zoology and botany. The biological passages of interest to us (in Book 12) begin with a discussion of “panspermia” or the universal seed of nature that gives rise to minerals, plants and animals. From an alchemical point of view that makes a great deal of sense (Rowland 2004). Kircher seems to have repudiated much of alchemy however. What matters is the claim that animals could be produced from non-living materials, such as excrement and rotting cadavers. Kircher gives quite a number of putative examples.

Kircher drew fire from a follower of Galileo, Francesco Redi (1626–1697) (Belloni 1981; Findlen 1993). Redi was physician to the Grand Dukes of Tuscany and an important figure at court. Galileo (1564–1642) himself had been condemned for heresy in April of 1633, but his scientific ideals were not extinguished and they were influential among naturalists (Freedberg 2002). Of course the solar system as presented in the Jesuit’s *Mundus Subterraneus* has the earth at the center. Redi published an essay on snakes entitled *Osservazioni intorno alle Vipere* [*Observations on Vipers*] in 1664, which Kircher criticized. Redi responded in an essay of 1671 entitled *Esperienze intorno a diverse Cose naturali e particolarmente a quelle che ci sono portate dell’Indie, scritta in una lettera al padre Atanasio Kircher della Compagnia di Gesù* [*Experiments on various Natural Objects, in particular on those which have been brought from the Indies, written in a Letter to Father Athanasius Kircher, S.J.*].

More importantly, Redi published his *Esperienze intorno alla Geuerazione degli’Insetti* [*Experiments on the Generation of Insects*] in 1668, i.e., after the publication of *Mundus Subterraneus* but before that of *Arca Noë*. In that publication, Redi reported his experiments and observations that seriously challenged the notion of spontaneous generation. Redi’s observations and simple experiments showed that the maggots that appear on meat and other non-living materi-

als are produced from eggs that are laid by flies. No maggots appeared in the food when the flies and their young larvae could not get access to it. More than one species of fly was involved, and they reproduced sexually. Kircher had claimed that living flies are produced from the bodies of dead flies, but Redi rejected his experiments purporting to show that. He repeated Kircher's experiments purporting to show that insects arise spontaneously from manure but ran the control of keeping some of it closed off, and the insects failed to appear. Redi had a good microscope for his day, and used it. For example, he found that scorpions that Kircher said were spontaneously generated actually were the offspring of a viviparous scorpion. As was customary among scientists in his day, Redi discussed the relevant literature going back to classical antiquity. He argued that accounts of spontaneous generation were fables. In *Arca Noë*, Kircher responded that his own observations were indeed valid. Conceding that point, of course, would have destroyed his whole argument. In a later work, *Osservazioni intorno agli Animali viventi che si trovano negli Animali Viventi* [*Observations on Living Animals that are Found in Living Animals*] (1684), Redi provided further experimental evidence. In addition, he showed that parasitic worms reproduce just like other animals, and this was a major advance in our understanding of parasites. The possibility of spontaneous generation under certain conditions was not excluded however, and Redi thought that gall insects are produced by the plants that form the galls.

The notion that the experiments of Redi, Spallanzani, and even Pasteur provided decisive evidence against spontaneous generation has been discredited by historians (Farley 1977). Nonetheless it seems quite obvious that Kircher and Redi represented two quite different attitudes toward knowledge. Kircher derived his natural history from privileged assumptions about the influence of God. The order of nature is the divine order. More importantly, the creation as a whole derived from the expiration of God, in Catholic iconography depicted as a bird flying over all things and inspiring every spirit. (see Fig. 1) The impulse of such expiration set them into being, and is effective in things as they still exist. Therefore everything is alive, for God is in everything.

Redi was more down to earth. For him the creation is just the entities that exist, something to be observed, dissected, and described. In addition to an ontological difference between them, there was also an epistemological one. Kircher's works have scientific content, but what he was writing about might better be called "illustrated metaphysics." Observation showed that things are as they should be. Knowledge was fundamentally ahistorical: what had been there all along simply had to be uncovered. Redi on the other hand was concerned with the truth or falsehood of the assumptions that were being made. The data of experience disconfirmed what had been expected and suggested alternatives. As a result, new conceptions of the world came into being, and knowledge was transformed. Science was fundamentally historical: it evolves.

The difference between the two attitudes is profound, and there is no way to reconcile them. The goals of rationalization are incompatible with those of rationality. Kircher carried his style of research about as far as it could go, which was to the point of collapse. With the passage of time, the kind of attitude that he represents became less and less respectable among scientists. By no means has it been abandoned altogether. Indeed, our own research on the history of German science in the early nineteenth century has laid bare the influence of occult metaphysics, including alchemy and numerology, on comparative anatomy and systematic biology (Ghiselin 2000; Breidbach and Ghiselin 2002). It would seem that the writings of Kircher were a major source of inspiration for such *Naturphilosophie*. Later in the nineteenth century, Darwin's discovery of natural selection showed that the apparent design in nature can be explained without recourse to the supernatural. More generally, however, it discredited any such effort to base scientific inference on supposedly privileged insight into the nature of the Deity (Ghiselin 2005). Not everybody was willing to accept that of course.

Spontaneous generation was a major part of the nineteenth century debates about evolution, in which religion, of course, played a major role (Farley 1977; Strick 2000). One reason why Louis Pasteur was so anxious to refute it was that spontaneous generation played a major role in the evolutionary philosophy of Lamarck and was, therefore, a threat to society. On the other hand, Pasteur's opponent, Felix Pouchet, maintained that spontaneous generation would help to explain how life had been created anew after universal catastrophes, which the paleontologist Georges Cuvier had invoked to explain discontinuities in the fossil record. Cuvier had treated the Noachian deluge as the last of these catastrophes. In England, Darwin's opponent, Richard Owen, advocated a version of evolution guided by divinely ordained laws of nature, with life arising spontaneously from non-living matter. On the other hand, Darwin and most of his supporters were opposed to spontaneous generation. It took a while to recast the issues in terms of biochemical evolution and for it to be generally understood that the old conceptions of origins were misguided. The archaic way of thinking, of course, has not fully died out, but at least scientists have better ways to spend their time than by fitting thousands of pairs of mammals and hundreds of thousands of pairs of insects into a few cubic cubits.

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REFERENCES

- BELLONI, L. 1981. Redi, Francesco. Pages 341–343 in C.C. Gillispie, ed., *Dictionary of Scientific Biography*, vol. 11. Charles Scribner's Sons, New York, New York, USA.
- BREIDBACH, O. 2004. Die letzten Kabbalisten, die neue Wissenschaft und ihre Ordnung. Bemerkungen zu den Traditionslinien bio- und neurowissenschaftlicher Forschung. Pages 63–76 in Rudolph Seising, Menso Folkerts, and Ulf Hashagen, eds., *Form Zahl, Ordnung. Studien zur Wissenschafts- und Technikgeschichte*. Franz Steiner Verlag, Place, Germany.
- BREIDBACH, O. 2005. On the representation of knowledge in Athanasius Kircher. Pages 63–76 in Helmar Schramm, Ludger Schwarte, and Jan Lanzardig, eds., *Collection — Laboratory Theater. Scenes of Knowledge in the 17th Century*, vol. 1. Walter de Gruyter, Berlin, Germany.
- BREIDBACH, O. 2006. *Goethe's Metamorphosenlehre*. Wilhelm Fink, München, Germany.
- BREIDBACH, O., AND M.T. GHISELIN. 2002. Lorenz Oken and *Naturphilosophie* in Jena, Paris and London. *History and Philosophy of the Life Sciences* 24:219–247.
- ECO, U. 1995. *The Search for a Perfect Language*. Blackwell, Oxford, UK.
- FARLEY, J. 1977. *The Spontaneous Generation Controversy from Descartes to Oparin*. The Johns Hopkins University Press, Baltimore, Maryland, USA.
- FINDLEN, P. 1993. Controlling the experiment: rhetoric, court patronage and the experimental method of Francesco Redi. *History of Science* 31:35–64.
- FINDLEN, P., ED. 2004. *Athanasius Kircher: The Last Man Who Knew Everything*. Routledge, New York, New York, USA.
- FREEDBERG, D. 2002. *The Eye of the Lynx: Galileo, His Friends, and the Beginnings of Natural History*. University of Chicago Press, Chicago, Illinois, USA.
- GHISELIN, M.T. 2000. The founders of morphology as alchemists. Pages 39–49 in M.T. Ghiselin and A.E. Leviton, eds., *Cultures and Institutions of Natural History*. Memoir 25, California Academy of Sciences, San Francisco, California, USA.
- GHISELIN, M.T. 2005. The Darwinian revolution as viewed by a philosophical biologist. *Journal of the History of Biology* 38:123–136.
- GODWIN, J. 1979. *Athanasius Kircher: a Renaissance Man and the Quest for Lost Language*. Thames and Hudson, London, UK.

- IDEL, M., R.C. KIENER, AND J. DAN, EDs. 1986. *The Early Kabbalah*. Paulist Press, Mahwah, New Jersey, USA.
- KIRCHER, A. 1646. *Ars magna lucis et umbrae in mundo, atque adeo miversa natura, vires effectusque uti nova, ita varia novorum reconditiorumque speciminum exhibitione, ad varios mortalium usus, panduntur*. Hermann Scheus, Rome, Italy.
- KIRCHER, A. 1652–54. *Oedipus Aegyptiacus. Hoc est Universalis Hieroglyphicae Veterum Doctrinae temporum iniuria abolitae Instauratio. Opus ex omni Orientalium doctrina & sapientia conditum, nec non biginti diversarum linguarum, autoritate stabilitum*. Typographica Vitalis Mascardi, Roma, Italy.
- KIRCHER, A. 1665. *Mundus Subterraneus*. Johannem Janssonium à Waesberge, Amstelodami [=Amsterdam, Netherlands].
- KIRCHER, A. 1675. *Arca Noë, in Tres Libros Digesta, quorum I. De Rebus quae ante Diluivium, II. De iis, quae ipso Diluivio ejnsque Duratione, III. De iis, quae post Diluivium à Noëmo Gesta Sunt, quae Omnia Novâ Methodo, nec non Summa Argmmentorum varietate, explicantur, & demonstrantur*. Johannem Janssonium à Waesberge, Amstelodami [=Amsterdam, Netherlands].
- KIRCHER, A. 1679. *Turris Babel, sive Archontologia*. Janssonio Waesbergiana, Amsterdam, Netherlands.
- REDI, F. 1664. *Osservazioni intorno alle Vipere fatte da Francesco Redi Gentiluomo aretino, Accademico della Crusca, e da lui Scritte in una Lettera all' Illustrissimo Signor Lorenzo Magalotti*. Insegna della Stella, Firenze, Italy.
- REDI, F. 1668. *Esperienze intorno alla Generazione degl'Insetti fatte da Francesco Redi, Gentiluomo Aretino e Accademico della Crusca, e da lui scritte in una Lettera all' Illustrissimo Signor Carlo Date*. Insegna della Stella, Firenze, Italy. [Also somewhat abridged translation by M. Bigelow, 1909. Open Court, Chicago, Illinois, USA.]
- REDI, F. 1671. *Esperienze intorno a Diverse Cose Natruali e particolarmente a quelle che ci son portate dall'Indie, Scritte in una Lettera al Padre Atanasio Circher della Compagnia di Gesù*. Insegna della Stella, Firenze, Italy.
- REDI, F. 1684. *Osservazioni intorno agli Animali Viventi che si Trovano Negli Animali Viventi*. Pier Matini, Firenze, Italy.
- ROWLAND, I.D. 2004. Athanasius Kircher, Giordano Bruno, and the *panspermia* of the infinite universe. Pages 191–205 in P. Findlen, ed., *Athanasius Kircher: the Last Man Who Knew Everything*, ed. P. Findlen. Routledge, New York, New York, USA.
- SCHMIDT-BIGGEMANN, W. 2001. Hermes Trismegistos. Isis und Osiris in Athanasius Kircher's *Oedipus Aegyptiacus*. *Archiv für Religionsgeschichte* 3:37–88.
- STRICK, J.E. 2000. *Sparks of Life: Darwinism and the Victorian Debates over Spontaneous Generation*. Harvard University Press, Cambridge, Massachusetts, USA.
- YATES, F.A. 1964. *Giordano Brmo and the Hermetic Tradition*. University of Chicago Press, Chicago, USA.
- YATES, F.A. 1979. *The Occult Philosophy in the Elizabethan Age*. Routledge & Kegan Paul, London, UK.